the scenes and shown the theoretical basis of the stage effects which he has witnessed. Let us consider the nature of a text-book written for this type of student.

Such a text must of necessity be analytical in character, although the formal mathematics used need be no more than that required for college entrance with the addition of the nomenclature of trigonometry. In order to show to the student that mathematics is really the language of the physicist, the book begins with a mathematical introduction. Geometrical optics, developed by the ray method from the principle of rectilinear propagation and the laws of regular reflection and refraction, illustrates the use of geometry and trigonometry. The vector idea is introduced by the statics of a rigid body. Finally, this introduction closes with a brief treatment of kinematics to bring before the student the idea of instantaneous rates of change and of the summation of varying quantities as shown by the slope and subtended area of velocity-time curves. Although no formal calculus is used, it is explained how average or effective values may be dealt with by simple algebraic formulae.

The material in the remainder of the book is grouped in the following parts:

(1) "Energy and steady fields." The concepts of energy, potential and fields of force are introduced with the field of gravity at the earth's surface which is considered as constant. Then the same ideas are applied to constant hydrostatic fields. Finally, universal gravitation, electric and magnetic attraction and electromagnetic radiation are discussed as inverse square fields.

(2) "Dynamics of a rigid body." The concept of inertia is introduced with a dynamical definition of mass. The parallelism between translational and rotational motion is emphasized.

(3) "Flow phenomena." Starting with the customary treatment of hydraulics, the analogy between the flow of water, heat, electricity, lines of electric displacement and magnetic flux is brought out.

(4) "Periodic phenomena." After pointing out the existence of a centripetal acceleration in circular motion with constant speed, the characteristics of simple harmonic motion are developed. It is shown that any system which follows a generalized Hook's law vibrates with this type of motion and often gives rise to a wave motion intimately related to it. Thus a great variety of phenomena from the fields of mechanics, sound, light and electricity is brought together on a theoretical basis and discussed with great economy of effort.

(5) "Kinetic theory." The actual mechanism behind these phenomena, which in the preceding sections are studied from the macroscopic point of view and considered as continuous, is here explained in terms of the motion of discrete electrons and molecules.

The whole development of the text is based on a rigorous set of definitions built up logically from five fundamental concepts—length, l, force, F, time, t, electricity, Q, and temperature. This group of fundamental concepts permits the use of a dimensional analysis which, in addition to checking the student's formulae and aiding him in changing units, gives a more concrete insight into the relations between the various concepts. For example, this analysis permits at once of the electromagnetic conception of light phenomena. Illumination is proportional to the energy which strikes a unit surface per second and thus has dimensions $[\ F\ t^{-1}\ l^{-1}\ ]$. This radiant energy depends upon the product of the electric and magnetic field strength in the advancing light wave. The electric field strength, defined as the force per unit charge or as a potential gradient has dimensions $[\ F\ Q^{-1}\ ]$. The magnetic field strength defined in terms of the magnetic effect of the current has dimensions $[\ Q\ t^{-1}\ l^{-1}\ .\ ]$ The product of these two field intensities is at once seen to have the same dimensions as the illumination.

In conclusion, if the aim of a physical science is to systematize our knowledge of the world about us, surely we should not be overwhelmed by the fascination of external phenomena but should look for general fundamental relations and deal with elementary college physics from the theoretical point of view.

NOEL C. LITTLE

BOWDOIN COLLEGE,
BRUNSWICK, MAINE

## HONEY BEES AND PERFORATED FLOWERS

IN SCIENCE 62, 134, August 7, 1925, Professor Burrill states that honey bees got nectar of *Diervilla florida* through holes made by carpenter bees. The hive bee has been seen making holes in flowers of *Aquilegia vulgaris* (Sprengel 1793, Mueller 1873), *Erica tetralix* and *Nepeta glechoma* (Mueller 1873). It gets nectar from holes made by other insects in flowers of *Trifolium pratense* (Mueller 1873, Belt 1875, Darwin 1877, Pammel 1883), *Aquilegia vulgaris, Corydalis cava, C. solida, Dicl̈ytra spectabilis, Lamium album, L. galeobdolon, Melampyrum pratense, Symphytum officinale, Vicia faba, V. sepium* (Mueller 1873) and *Monarda fistulosa* (Robertson 1892).

Having observed 15,172 insect visits to 441 local insect flowers, I have found only four flowers perforated, and then only by *Leionotus foraminatus* and *L. dorsalis*. The following insects used the holes: on *Monarda fistulosa*, besides the hive bee, one *Ceratina*,

seven Halictidae, one *Sphex;* on *M. bradburiana,* none; on *Scutellaria canescens,* three Halictidae; on *Penstemon laevigatus, Leionotus anormis.*

At Orlando, Florida, I saw two Eumenidae and two Vespidae getting nectar of *Gaylussacia hirtella* from holes made by *Odynerus erinnys.*

CHARLES ROBERTSON
CARLINVILLE, ILLINOIS

## A NOTE ON A ROT OF THE SMYRNA FIG IN CALIFORNIA

AN article published in SCIENCE, August 14, 1925, page 161, by P. D. Caldis, of the University of California, entitled "A rot of the Smyrna fig in California," has been a source of confusion in regard to the name of the fungus causing the rot. The writer has already had several inquiries from pathologists and cataloguers in Washington and elsewhere how to index it.

In the spring of 1924 the fungus was isolated from the fig and the Blastophaga in this laboratory, and as the typical curved septate spores were obtained from both sources it was determined to be a Fusarium. Report of the work was sent to the Fig Growers Association in California in September, 1924. The species was identified by Dr. Sherbakoff in January, 1925, from our cultures and subsequently from one of Mr. Caldis' cultures which had been held under our laboratory conditions for eight months, as *Fusarium moniliforme* Sheldon. It is true that *Fusarium moniliforme* Sheldon has been confused with *Oospora verticilloides* Sacc. when it produces only the microconidial type of spores and on that account it has sometimes been listed as an Oospora. But it is not an Oospora, as might be inferred from Mr. Caldis' article.

The fungus has also been called a Cylindrotrichum, but the presence of curved septate Fusarium spores in infectious cultures determines its proper classification.

NELLIE A. BROWN
LABORATORY OF PLANT PATHOLOGY,
WASHINGTON, D. C.

## SCIENTIFIC BOOKS

*The Downtonian Fauna of Norway.* I. *Anaspida, with a Geological Introduction.* By JOHAN KIÆR. Pp. 139, with 50 text figures and 14 plates. Kristiania, 1924, Videnskapsselskapets Skrifter. I. Mat.-Naturv. Klasse. 1924, No. 6.

THIS fine monograph is the first part of an extended memoir on the remarkable upper Silurian fauna discovered by the author and his wife in 1909 at Ringerike, in the southern part of the Oslo area. About 2,500 specimens of crustaceans, merostomes and fishes have been obtained, of which only the anaspidans, including *Pterolepis nitidus* Kiær, *Pharyngolepis oblongus* Kiær, and *Rhyncholepis parvulus* Kiær, are here discussed.

Traquair's views as to the orientation of the body are shown to be incorrect, the dorsal and ventral surfaces being reversed, as had been suspected by some students.

The scale system is shown in all three genera in the most detailed fashion. On the head the hitherto unknown dorsal and gular plate systems, formed by the fusion of smaller scales, is made known and an adequate terminology is proposed. The plates are intimately related with the openings in the head. Of these there are on the dorsal surface, besides the large eyes, a small median opening between the orbits believed to have lodged the pineal organ, and a somewhat larger unpaired opening in advance of this, supposed to be the single nostril.

The large terminal mouth is bounded superiorly by the anterior plates of the dorsal cranial system. Inferiorly it is bounded in one form by a small area of transverse scales, in another by a single moderate-sized median plate, and in the third by well-developed paired plates strengthened by the powerful gular system—apparently indirect stages in the formation of a large, powerful beak. There are no traces of teeth.

As has been known, there are a number (eight to fifteen) of circular branchial openings arranged in an oblique band back of the head. Just posterior to the lower end of this band there is a strong sharp spine in the Norwegian genera which the author considers as a possible homologue of the pectoral fins of the true fishes. There are unpaired anal and caudal fins. The latter is not, as was generally supposed, a normal heterocercal tail, but a reversed heterocercal one, strangely similar to that of an ichthyosaur but unknown among real fishes.

There is no trace of a sensory canal system or of a bony axial skeleton.

Clear, well-drawn reconstructions of the three genera are given.

The remaining fifty-five pages are devoted to the general bearing of these very welcome new facts. As regards the "jawless" nature of these forms, Kiær concludes that there was a definite cartilaginous stiffening around the mouth "which, it is highly probable, may be compared with the mandibular arch in real fishes." The presence of a functional pineal eye and of an unpaired narial opening, believed to be proven, is stressed. The branchial system is held necessarily to have consisted of cyclostome-like pouches, probably without any homologue of the branchial arches of true fishes.